

Proportional Reasoning

March 31, 2012
MaTHink Conference

Riverside County Office
of Education

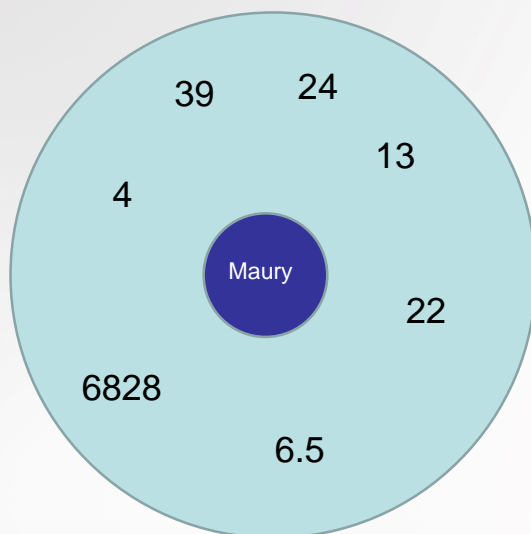


Goals of this Training

- Learn what proportional reasoning is and is not
- Experience activities involving proportional reasoning
- Improve teacher proportional reasoning ability
- Understand the implications of proportional reasoning in the middle school math curriculum



Getting to Know You



Create a circle map, put your name in the inner circle.

Write numbers in the outer circle that have some meaning to you.



What is Proportional Reasoning?

Proportional reasoning is the ability to think about and compare multiplicative relationships between quantities.

Van de Walle, 2006

It is a way of thinking, not an algorithm to be used in solving problems.

Thompson & Bush, 2000



Proportional Reasoning Methods

- Iterating or partitioning
- Compare the two numerical values by finding how many times greater one value is of the other value.



Iterate or Partition

- I have a leaky faucet at home. The faucet leaks at a rate of 6 ounces every 8 minutes.

Ounces	6	12	18	2	3	20
Minutes	8	16	24	8/3	4	?



Finding Times Greater

- I have a leaky faucet at home. The faucet leaks at a rate of 6 ounces every 8 minutes.
 - 8 is $1 \frac{1}{3}$ times greater than 6
 - How long would it take for 10 ounces of water to drip?
 - 6 is $\frac{3}{4}$ of 8
 - How many ounces of water will drip in 20 minutes?



Proportional Thinkers

Understand ratios as distinct entities representing a relationship different from the quantities they compare

Have a sense of covariation, two quantities vary together and are able to see how the variation in one coincides with the variation in another.

Recognize proportional relationships as distinct from nonproportional relationships in real-world contexts.

Develop a wide variety of strategies for solving proportions or comparing ratios, most of which are based on informal strategies rather than algorithms..



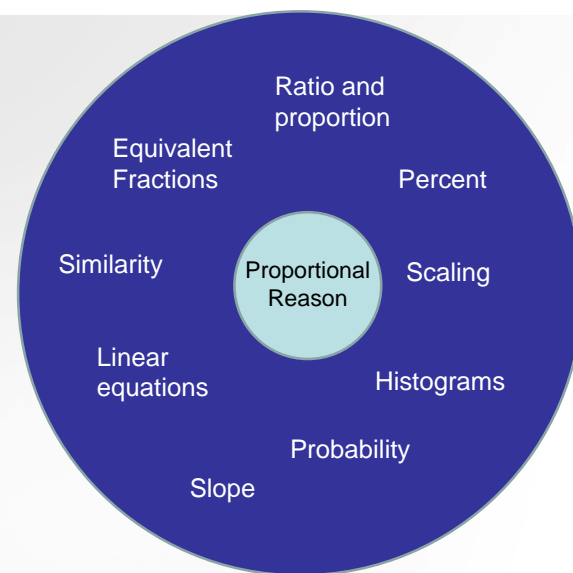
How Important is Proportional Reasoning?

Proportional reasoning is the capstone of the elementary school curriculum and the cornerstone of algebra, high school mathematics, and science.

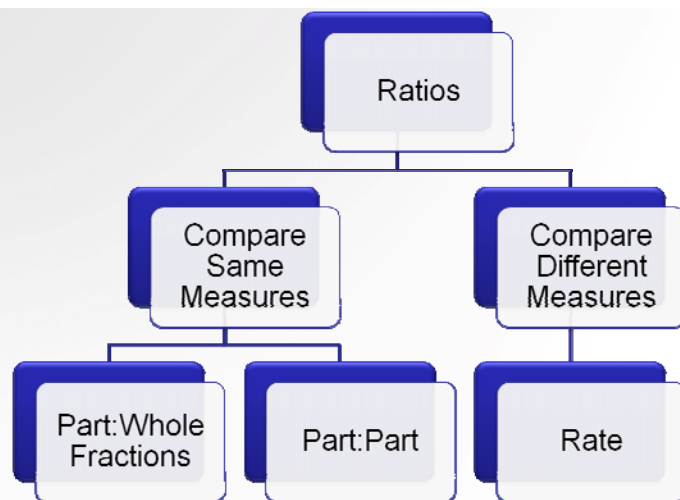
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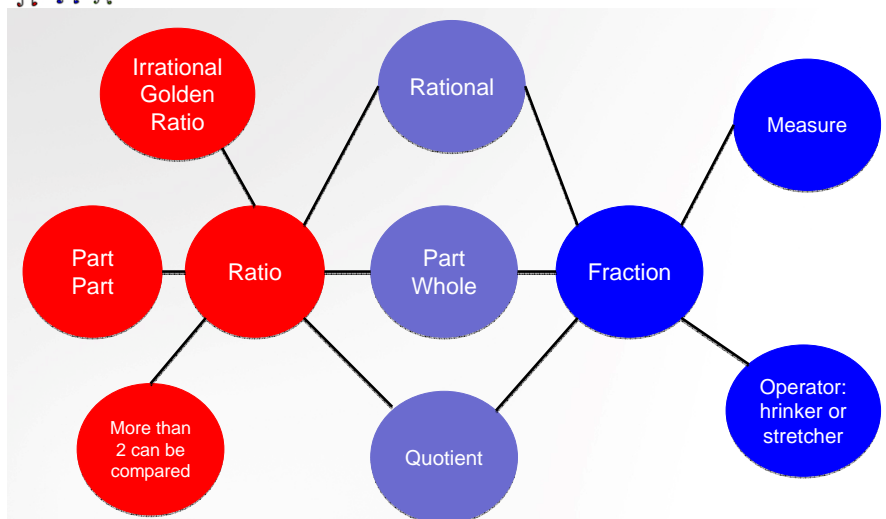
Proportional Reasoning Topics



Ratio Family Tree



Ratio vs. Fractions





Your Turn

Find Problem Set

Types of Ratios



Key Ideas of Proportional Reasoning

- Students must recognize the difference between absolute, or additive, and relative, or multiplicative change.

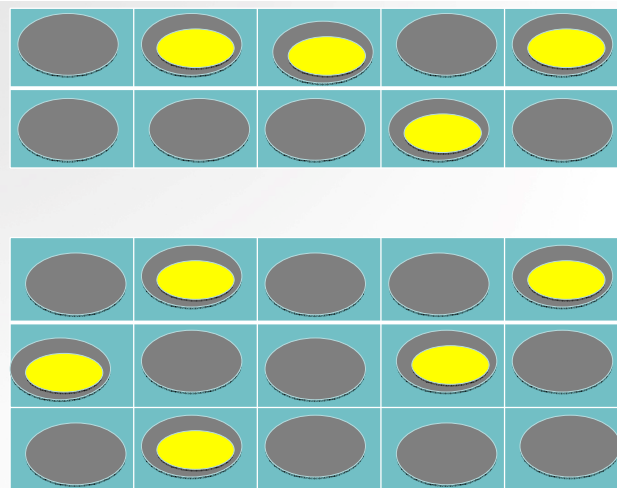


Problem for You

Two weeks ago, two flowers were measured at 8 inches and 12 inches, respectively. Today they are 11 inches and 15 inches tall. Did the 8 inch or the 12 inch flower grow more?



Which box of candy is nuttier?





Recognizing Graphed Relationships

- Directions
 - Graph each set of ordered pairs
 - Name another ordered pair belonging to the set
 - Determine whether $(0,0)$ belongs to the set
 - Draw a line through the graphed points, extend to intersect the x-axis, y-axis, or both.
- Debrief
 - Which sets of points represent proportions? Explain.



Key Ideas of Proportional Reasoning

Students must recognize situations in which using a ratio is reasonable or appropriate.



Making Sense

Find the problem set titled Making Sense

Discuss these at your table group

Share out results



Key Ideas of Proportional Reasoning

- Students must recognize that the quantities that make up a ratio covary in such a way that the relationship between them remains unchanged, or is invariant.
 - Students see equivalent fractions as totally different rather than representing the same relationship.



Equivalent Rates

- Different Objects—Same Ratios
 - On which cards is the ratio of trucks to boxes the same?
 - Do any of the cards show a unit rate? Which one? How do you know?
 - What would the unit rate be for the other cards? Explain.
- What do you notice when you compare trucks to trucks and boxes to boxes in your separate sets of cards?

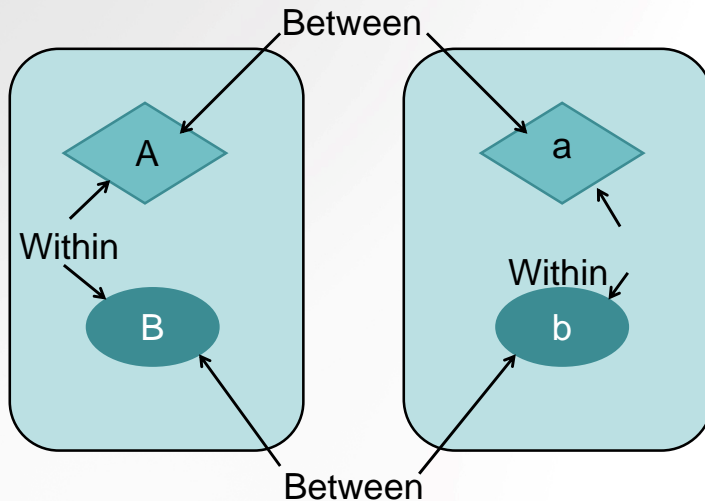


Within and Between Ratios

- Remember the trucks and boxes
 - Within ratios - a ratio of two measures in the same setting.
 - Between ratios – a ratio of two corresponding measures in different situations.



Within and Between Ratios



Within and Between Ratios

Tammy bought 3 widgets for \$2.40. At the same price, how much would 10 widgets cost?

Tammy bought 4 widgets for \$3.75. How much would a dozen widgets cost?



Key Ideas of Proportional Reasoning

- Students develop the ability to build increasingly complex unit structures, this is called *unitizing*.



Reasoning vs. Algorithm

- Forcing students to apply algorithms will only mask the true thinking of your students.
- Student's may need as much as 3 years' worth of opportunities in multiplicative situations in order to adequately develop proportional reasoning skills.
- Premature use of rules encourages students to apply rules without thinking and thus the ability to reason proportionally often does not develop.



Compare Ratios

Two camps of Scouts are having pizza parties. The Bear Camp ordered enough so that every 3 campers will have 2 pizzas. The leader of the Raccoons ordered enough so that there would be 3 pizzas for every 5 campers.

Did the Bear campers or the Raccoon campers have more pizza to eat?

Solve by any method except cross products.



Compare Ratios

- Try some more problems using multiple strategies
 - Problem Set: Compare Ratios
 - Share out some strategies



Scaling with Ratio Tables

- Consider this rate: Forest rangers found 75 pine trees on 5 acres of land.
 - How many trees would be expected on 65 acres of land?
 - How many acres of land would be needed for 750 trees?
- What strategy (besides a proportion and cross product) can be used to solve this problem?
 - Iterating and partitioning method



Scaling with Ratio Tables

- Try some on your own
 - Problem Set: Using Ratio Tables
 - Share out solutions



Pencils for Giants

- Which pencil could belong to a giant?
 - Why does your group think that pencil will belong to a giant?
 - Can you prove it?



Pencils for a Giant

- If this is the pencil that belongs to the giant, how tall is the giant?
 - Can your group justify that the giant must be that tall?
 - Could we have a range of heights for the giant? Why or why not?
- Debrief the activity
 - What do students need to consider when given this task?
 - Which part does your group feel they will have the most difficulty with?
 - Would you make changes to the task? What?



Sample Assesements

- Rhode Island Department of Education
- New York City Department of Education



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Closure

- Significant ideas from the day.
- Complete an evaluation form.
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